

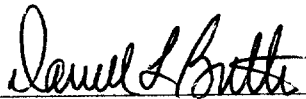
Solving Ill-Structured Problems: A Comparison of
Brainstorming, Incubation, and the Hierarchical Technique
In Paper and Computer Conditions
An Honors Thesis (HONRS 499)

by

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Purpose of Thesis

In the complex world of everyday life, ill-defined problems abound. Three problem solving techniques that are used to help solve these ill-defined problems are incubation, brainstorming, and the hierarchical technique. With the advent of computer technology, computer programs are also now being incorporated into problem solving practices. Because the “best” solutions to problems depend on the context of the problem, it is necessary to assess problem solving techniques using a variety of different qualitative measures such as quality, originality, and practicality. This study was conducted to both compare the effectiveness of incubation, brainstorming and the hierarchical technique and to assess the effect of technology on problem solving. One hundred and forty-three Ball State University students participated in the study. Students were asked to describe a personal problem and then generate solutions to this problem. They were then given training and allowed to return to their problem. Upon generating as many solutions as possible, students were asked to evaluate their solutions. It was found that the hierarchical computer condition produced the most solutions. It was also found that training helped to maintain pre-training quality ratings of solutions.

Solving Ill-Structured Problems: A Comparison of Brainstorming, Incubation, and the Hierarchical Technique in Paper and Computer Conditions

In their everyday lives, people encounter countless ill-defined problems such as how to improve one's relationship with a significant other or how to have enough money to take a family vacation. There are many problem solving strategies people can employ to solve such problems. Three examples of such problem solving strategies are incubation, brainstorming, and the hierarchical technique.

Incubation

One of the most basic problem solving approaches is the process of incubation. Incubation is defined as a sudden and unexpected insight into a problem's solution after temporarily putting the problem aside (Smith & Blankenship, 1989). There have been a variety of different causes postulated to explain the occurrence of incubation. One of the most thoroughly researched causes of incubation is the idea of fixation. Woodworth and Schlosberg (1954) described fixation as an occurrence in which the "thinker makes a false start [and] he slides insensibly into a groove and may not be able to escape at the moment" (p. 841). During a period of incubation, the thinker is able to break free from this erroneous mental set and approach the problem from a different perspective. Types of fixation include induced mental sets, functional fixedness, and the tip-of-the-tongue phenomena (Woodworth & Schlosberg, 1954). Recent studies conducted by Smith and Blankenship (1989) support the findings of Woodworth and Schlosberg. After conducting a variety of different fixation studies, Smith and Blankenship (1989)

concluded that the unexpected insight which occurs during incubation is the result of looking at the problem from a perspective that is different than the original one.

Despite the findings of Smith and Blakenship (1989), empirical evidence concerning the effectiveness of incubation remains inconsistent. Studies conducted by many researchers have been unable to find any significant incubation effects (Gick & Holyoak, 1980; Gall & Mendelsohn (1967); Olton & Johnson, 1976; Dominowski & Jenrick, 1972).

Brainstorming

Alternatives to the passive approach of incubation have been proposed. One such alternative is brainstorming. Brainstorming was originally designed to assist in the creative problem solving of groups. In his book Applied Imagination, Osborn (1953) claimed that both the quality and the quantity of solutions produced by groups could be significantly increased by adhering to the four rules of brainstorming. Osborn's four brainstorming rules are as follows: 1) Defer Judgments, 2) Generate as many solutions as possible, 3) Record all ideas, and 4) Combine and build on existing ideas. In Applied Imagination, Osborn (1953) gives several examples in advertising where brainstorming had helped increase group productivity. Sappington and Farrar (1982) have also found brainstorming to be successful in helping enhance individual creative problem solving.

Despite Osborn's beliefs concerning brainstorming, research has shown there are two major problems with brainstorming. First, studies show that nominal groups (groups in which individuals first generate ideas independently and then these ideas are combined to form a group set of ideas) produce more ideas than those in verbally interactive groups (Taylor, Berry, & Block, 1958 to Diehl & Stroebe, 1987). These findings contradicted Osborn's original ideas of increased productivity as a result of working in a group setting (1953).

Various explanations from several theoretical perspective have been proposed to explain this decrease in productivity. The three primary explanations are based on a social psychological mechanism, an economic mechanism, and a procedural mechanism. (Gallupe, Cooper, Grise, and Bastianutti, 1994).

Social Psychological Mechanism. According to the social psychological mechanism, a decrease in productivity observed in the verbally interactive groups results from evaluation apprehension (Diehl & Stroebe, 1987). Evaluation apprehension is considered to be a "fear of negative evaluation by other group members" (Diehl & Stroebe, 1987). Although in Osborn's instructions on brainstorming participants are told not to be critical of their own or others ideas (1953), research has shown that participants solution productivity decreases when they are told they are being watched and evaluated on their solutions (Diehl & Stroebe, 1987) or when other group members are considered to be experts in the topic being discussed (Collaros & Anderson, 1969). In their experiment on

evaluation apprehension, Diehl and Strobe (1987) found that participants working individually produced significantly more ideas than those working in groups of four ($F(1,8) = 74.08, p < .01$).

Economic Mechanism. A decrease in productivity as explained by the economic mechanism is the result of free riding. Free riding is described as “the tendency of some group members to not work as hard in a group as they would if they worked alone” (Gallupe et al., 1994). A variety of different explanations have been proposed to explain free riding including “the lack of incentives for contributing, the dispensability of individual contributions, and the cost of contributing” (Gallupe et al., 1994). In an experiment on free riding, Diehl and Strobe (1987) found that nominal groups produced significantly more ideas than verbally interactive groups ($F(1, 8) = 87.56, p < .05$).

Procedural Mechanism. Finally, the procedural mechanism explains decreased productivity in a group setting as a result of production blocking. Production blocking is the result of only one person being able to talk at a time in a group. This mechanical problem limits the idea generation and production time of each member of the group. Diehl and Strobe (1987) found that participants who were allowed to verbalize their ideas as they occurred produced approximately two times as many solutions as those participants who were forced to wait their turn. The decrease in production in the blocked group was not found to be due to reevaluation of ideas or forgetting of personal ideas while listening to ideas of others. Instead Diehl and Strobe (1987) hypothesize that

production blocking in brainstorming groups was caused by time delays which prevent the development of new ideas.

The second problem with brainstorming relates to the kinds of solutions produced using brainstorming. Brainstorming tends to produce solutions that are irrelevant, bizarre, or silly. In a study conducted by Sappington and Farrar (1982) it was found that research brainstorming ideas were often impractical and unrealistic for use in everyday problem solving. Because brainstorming was originally designed for creative problem solving, it is understandable that it would not be as effective in solving practical real world problems.

Possible solutions to brainstorming problems. Technology is one possible solution to the performance problem of brainstorming groups. The role of technology in problem solving has been rapidly expanding since the introduction of early problem solving computer software like VisiCalc and ThinkTank (ThinkTank itself was called a “brainstorming tool”) (Bonner, p. 77, 1984). Rather than spending hours or perhaps days planning and editing spreadsheets or outlines on paper, these computer programs allowed an individual to record ideas and then return to rearrange these ideas at a later time. Such rearrangement could quickly and easily be done with the click of a few buttons rather than rewriting the entire document (Bonner, 1984). With the progression of such computer software, the advent of a computer program devoted solely to brainstorming was eminent. In 1987, Nunamaker Jr., Applegate, and Konsynski developed a Electronic

Brainstorming (EBS) system entitled Group Systems which was devoted solely to facilitating the problem solving technique of brainstorming.

When using Nunamaker Jr., Applegate, and Konsynski (1991) original Electronic Brainstorming technique, sixteen individuals sat around a U-shaped table in face-to-face groups. In the interactive process meeting style, all computer terminals were connected to one another and all were running the Electronic Brainstorming software. Individuals were allowed to enter their ideas about a given problem into the computer program in an anonymous fashion. Their ideas as well as the ideas of the other participants would then appear on the screen in a random order. Individuals were also given the option of accessing additional random ideas produced by others to aid in the brainstorming process by pressing a specific command key (Gallupe, Bastianutti, & Cooper, 1991).

The introduction of the Electronic Brainstorming technique sparked a renewed interest in brainstorming by cognitive psychologists. A study conducted by Gallupe et al. in 1991 demonstrated that electronic brainstorming groups produced more solutions than verbal brainstorming groups ($M_s = 50.00$ and 39.80 respectively). In 1992 Gallupe, Dennis, Cooper, Valacich, Bastianutti, and Nunamaker, Jr. conducted a study that showed that electric brainstorming helped significantly reduce evaluation apprehension. In a study done in 1994, Gallupe et al. found that electronic brainstorming helped reduce production blocking. Also a study by Valacich, Dennis, and Connolly (1994) demonstrated that electronic brainstorming works to reduce free riding. As can be seen

by the results of the various studies mentioned above, electronic brainstorming has done a lot to help reduce the major performance problems of brainstorming.

Hierarchical Technique

Although technology helps reduce the nominal group problem, it does not solve the “junk” solutions problem. Researchers have considered several alternatives to brainstorming to solve this problem. The hierarchical technique proposed by Butler & Thomas (in press) is an example of one such alternative. A hierarchy is defined as a process by which ideas are organized into categories. By organizing solutions into a hierarchy, participants are motivated to find the “best” solutions to their problems thus decreasing irrelevant or impractical solutions. Like in brainstorming, participants begin the problem solving process by first generating as many solutions to a problem as possible. After this generation stage, the organization of their ideas into a hierarchy occurs. The rules for generating a hierarchy are as follows: 1) Find “general” solutions to the problem, 2) Generate new ideas that are types of the general ones, and 3) Consider opposite of ideas.

To better exemplify the hierarchical technique, the following problem will be explored using the hierarchical technique: “Chris, a college student, needs \$300 to pay for damages to his or her apartment. Chris has 30 days to come up with the money or be evicted.” The first step using the hierarchical technique is to generate several possible solutions to this problem such as borrowing money from his parents, selling his car, and

getting a part-time job. When one was unable to generate any new solutions, one begins to build a hierarchy. First one finds general solutions amongst the specific ones. Three general solutions based on the specific solutions mentioned above include borrow money, sell things, and work. Second one then generates new solutions that fall under the general categories such as borrow money from the bank, sell television, and get a second job. Finally, one considers the opposite of the general categories that one generated. Rather than selling things, one might rent out various belongings to others for a fee. Preliminary studies on the hierarchical technique have shown promising results (Butler & Kline, in press; Butler & Thomas, in press).

Technology usage in individual problem solving

Because electronic problem solving technology has been effective in helping increase productivity in group settings, it opens the door to research on the effect of technology on individual problem solving. The question of “Does technology significantly increase individual productivity over traditional paper and pencil methods?” has only begun to be investigated. In a study by Valacich et al.(1994), researchers separated off a group of participants and had them generate ideas for an artificial problem on paper rather than typing their ideas into the computer. Upon comparing the number of ideas generated by those using paper to those using the computer, no significant difference was found in the number of solutions generated between typing and writing.

Since research into the effect of technology on individual productivity is limited, it is necessary to speculate on what makes technology usage different from the traditional paper and pencil methods. One such difference is the means by which information is recorded. When using a computer, one types the information onto a screen rather than writing ideas onto a piece of paper. In today’s society typing is a relatively common skill particularly for college age students. Familiarity with computers may help to enhance the productivity of a college age sample. However, these results may not generalize to different populations. A lack of typing skills or familiarity with a keyboard could easily work to inhibit idea generation in different samples. Another difference between computers and paper and pencil methods is the area in which ideas are generated. When

using paper, the idea generation area is simply the paper upon which one is writing. Changes to the area in writing require a great deal of effort (i.e. rewriting the organized ideas, drawing arrows, or erasing and starting over). The effort needed to help make changes on paper may work to block the production of ideas. When using computers, the idea generation area is a computer screen. Ideas can be quickly and easily rearranged in an effort to utilize the problem solving steps of both brainstorming and the hierarchical technique. The energy that would be used to make changes using the paper method can be applied to idea generation.

Measurement of the dependent variables

As mentioned previously Osborn's original ideas on brainstorming were designed for creative problem solving. Osborn (1953) claimed that brainstorming would not only increase the number of solutions produced by those using the technique but also their solutions would be more original. However, when people are working on real world problems such as finding money for college or resolving a conflict with a friend, creative and original solutions are not always appropriate or desirable. Inventing a new type of automobile engine that cuts down on air pollution and marketing it to all automobile manufacturers may be a highly original way to earn money for college. However, for the average person this idea is terribly impractical and would probably never be undertaken in an attempt to solve his or her problems. Solutions such as getting a summer job or selling prized possessions are more practical solutions that would be

more likely undertaken to solve the problem. When determining what is the “best” solution to a problem, one must consider the context in which the problem occurs. If one is trying to find inspiration for a song, creative and original ideas are highly desirable. However if one is looking for a more efficient ways to organize one’s time, practical and efficient solutions would be more suitable.

Major reasons for this study

The following study was conducted for two main reasons. The first reason was to compare the solution productivity, as well as, the solution evaluation in the areas of quality, originality, and practicality of the problem solving strategies of incubation, brainstorming, and the hierarchical technique. Based on previous research, we predict that participants in using brainstorming and the hierarchical technique will produce more ideas than those using incubation. We predict that those using incubation will also rate their solutions lower in quality, originality, and practicality. Based on the previous research of Osborn (1953) and others, we predict that participants using the brainstorming technique will rate their solutions as more original than those using the other two techniques. As a result of nature of the hierarchical technique, as well as, previous research findings, we predict that participants using the hierarchical technique will rate their solutions as higher in quality and more practical than those using the other two techniques.

The second reason for the study was to explore the effect of recording technology on problem solving. We had two major reasons for such exploration. First we wanted to verify that using technology did not inhibit the idea generation process. Based on the findings Valacich et al. (1994), we predict that technology will not impede the idea generation process. Second, we wanted to see if technology could help enhance the process of idea generation. Based on the research of Butler and Kline (in press), as well as, Butler and Thomas (in press), we predict that technology will help in the enhancement of idea generation.

Method

Participants

The participants in this experiment consisted of 143 Ball State University students enrolled in a Psychology 100 class. Students participated in the experiment in order to fulfill a research requirement for their class. The students were a median age of 19 years old.

Procedure

Each experimental session consisted of a maximum of four participants. Participants began the experiment by giving written descriptions of five ill-defined problems they were currently having or had encountered in the past but had not been able to solve. They wrote a few sentences on each problem on a separate sheet of paper. Next, the participants were asked to restate each of their problems in a single sentence in a "How can I..." or "Should I..." form. Then participants were asked to rank their problems in regard to personal importance on a scale of one to ten (one being least important and ten being most important). The participants were then asked to decide if a problem solving technique like brainstorming would be helpful in solving their problems. Participants were asked to write their first and last initials and problem number (one through five) at the top of each problem sheet. Once the participants had completed their descriptions, the experimenter determined which problems were generation problems. If there was more than one generation problem, the experimenter chose the one rated as more important.

Once each participant in an experimental session had been assigned a generation problem, each participant was asked to generate as many solutions as possible. Solutions were recorded on a blank sheet of paper using red ink. The participants worked until they believed they could not think of any more solutions. Solution generation took approximately 25 minutes.

Participants were then randomly assigned to training conditions (for example, paper hierarchical or computer brainstorming) with the restriction that near the end of the study conditions were assigned to make the number of participants/conditions approximately equal. Everyone run at the same time were assigned to the same condition.

One of the six possible training conditions was paper incubation. Participants in this condition engaged in an incubation task rather than receiving any sort of formal training. The incubation task consisted of following along while the experimenter read a story (see Appendix A for story and Appendix H for instructions). After the story had been read, the participants engaged in a debate with the other members of the group on an issue related to the story. Discussion time ranged from five to twenty minutes.

Another possible training condition was computer incubation. Participants in this condition were first given instructions on how to run the computer program (see Appendix B). Training took approximately five minutes. They then engaged in the same incubation task as those in the paper incubation group. Once again discussion ranged from five to twenty minutes.

The third possible training condition was paper brainstorming. Participants in this group were given instructions in the rules of brainstorming as they worked through a sample problem with experimenter (see Appendix C). Training lasted approximately 20 minutes.

The fourth possible training condition was computer brainstorming. Participants in this group were given instructions in both the rules of brainstorming and how to run the computer program as they worked through a sample problem with experimenter (See Appendix D). Training lasted approximately 25 minutes.

The fifth possible training condition was paper hierarchical. Participants in this group were given instructions in the rules of the hierarchical technique as they worked through a sample problem with the experimenter (see Appendix E). Training lasted approximately 20 minutes.

The final possible training condition was computer hierarchical. Participants in this group were given instruction in both the rules of the hierarchical technique and how to run the computer program as they worked through a sample problem with the experimenter (see Appendix F). Training lasted approximately 25 minutes.

After their "training", participants returned to their own problem and continued to generate solutions. Those on paper were given pens with black ink to distinguish pre-training from post-training. Those in the computer group simply returned to typing their solutions into the computer (the computer program used in the study was designed so that

it was able to tell pre from post-training solutions). The students worked until they believed they could not think of any more solutions which ranged from 5 to 20 minutes.

Finally, the participants were then asked to evaluate each of their solutions on the basis of the overall quality, originality, and practicality. Participants in the paper condition were given a solution rating sheet (See Appendix G) upon which to evaluate their solutions. Participants had number all their solutions starting with those in the pre-training condition. Overall quality was rated as: excellent (4), good (3), OK (2), poor (1), or irrelevant (0). Overall originality was rated as: very unusual-probably only I would do it (4), unusual-few would think of (3), somewhat unusual-some would think of (2), common-many would think of this (1), or very common-everyone would think of (0). Overall practicality was rated as: I would do it (4), I likely would do it (3), I might do it (2), I might not do it (1), or I would not do it (0). Participants in the computer conditions were shown their solutions again one at a time (starting with their pre-training solutions) and electronically given the same scales with which to evaluate their solutions.

Design

There were three different independent variables in this study. The first independent variable was problem solving approach (three levels between group): incubation, brainstorming, and hierarchical technique. The second independent variable investigated was technology (two levels between group): paper and computer. The third independent variable was time (two levels within group): before and after instruction. The dependent

variables were the number of solutions and self-ratings of solution quality, originality, and practicality.

Results

ANOVAs with two between group variables, problem solving approach and technology, as well as, one within group variable, time, were computed for the four dependent variables: number of solutions generated before instruction, mean quality, mean originality, and mean practicality. Problem solving approach, technology, and time all influenced problem solving ($F(2, 142) = 3.21, p < .05$). The hierarchical technique and brainstorming produced significantly more solutions than incubation (Scheffe-hierarchical = 7.51, $p < 0.0001$, Scheffe-brainstorming = 5.63, $p < 0.0001$). The mean number of solutions generated by those using the hierarchical technique was about two ideas more than those using brainstorming but the difference was not significant ($p = 0.064$).

Practicality ratings of solutions by the participants showed no significant effects in relation to problem solving approach and technology. Overall practicality was significantly lower after training (mean before = 2.62 and mean after = 2.32; $F(1, 142) = 7.36, p < .01$). Quality ratings of solutions by the participants did not differ significantly as a function of technology or approach. However mean quality rating before was 2.88 and mean after training was 2.46. This difference was significant ($F(1, 142) = 19.05, p < .001$). Originality ratings of the participants exhibited significant effects with respect to both time and problem solving approach. Both brainstorming (Scheffe = .68, $p < .001$) and the hierarchical technique (Scheffe = .54, $p < .001$) produced a significant increase in

the originality ratings of solutions after training but incubation (Scheffe= .07, ns) did not.

Discussion

As can be seen in the preceding results section, there were several significant findings. One significant findings was the combination of the hierarchical technique with a computer program significantly increased the number of solutions produced by the participants during problem solving. Another significant finding was there were several important findings regarding the originality ratings of the participants. First, training in the hierarchical technique and brainstorming lead to an increase in originality in the participants' solutions. Second, although there was no significant difference between the originality ratings of those in the brainstorming versus the hierarchical technique, those participants who used brainstorming produced significantly more original solutions than those who used incubation. Third, the mean originality ratings after training were relatively low.

The finding that the combination of the hierarchical technique and technology produced the most solutions helps lend support to the idea that both the hierarchical technique and technology aid in solution production of ill-defined problems. However what exactly about each of the techniques helps aid the problem solving process remains to be discovered. The difference in solution production between traditional paper and pencil methods and technology are probably due to the increase ease of solution rearrangement provided by the computer software. Because the hierarchical technique requires the user to build onto existing ideas, as well as, creating idea hierarchies, the

ability of the technology users to more easily move their ideas probably helped to enhance the problem solving effects of the hierarchical technique.

The finding that the mean quality dropped only slightly after training of all three types of problem solving techniques provides evidence for the effectiveness of problem solving approaches as aids to the process of solution production. It also leads to the question of why such problem solving techniques help to maintain a relatively high degree of quality. Generally when people are searching for solutions to a problem, the first solutions that are produced are those people find of the highest quality and are most likely to employ in solving their problem. Ideas that occur later on usually reflect the frustration and fatigue of the person engaged in the solution search. Ideas that are produced during this time are generally not seen as particularly high in quality and are not very likely to be employed in solving the problem.

The reasons why incubation would help to maintain the quality of solution production are perhaps best explained by previous incubation research. The ideas that incubation allows for a mental break from the problem, a means of looking at a problem from a different perspective, or a means for the unconscious works on the problem while one consciously engages in other tasks are all plausible ideas. The reason why brainstorming and the hierarchical technique aid in the maintenance of the quality of solution production may be the result of the fact that these two techniques provide rules for generating solutions. Rather than randomly searching one's memory or imagination for solutions, both brainstorming and the hierarchical technique provide a structured means

of solution search. Although too much structure may limit people's solution production, the loose framework provided by brainstorming and the hierarchical technique may help people keep their focus and reduce frustration and fatigue thus allowing for the maintenance of high quality solutions.

The mixed findings about originality with regards to brainstorming versus the other two problem solving approaches, as well as, the overall low ratings in originality can perhaps best be explained by the fact that the participants were working on personal problems. When people are attempting to solve a personal problem, they tend to focus on the production of more practical solutions rather than original ones. Because the participants in this study were trying to find the "best" solutions to their problems and "best" was generally seen as more practical in this context, the effects of brainstorming on originality enhancement were not as evident. In another study done by Butler and Thomas (in press), an imaginary problem was given to the participants and originality after training was higher for brainstorming than the hierarchical technique.

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Appendix A

The Baroness Story

As he left for a visit to his outlying districts, the jealous baron warned his pretty: "Do not leave the castle while I am gone, or I will punish you severely when I return!"

But as the hours passed, the young baroness grew lonely, and despite her husband's warning she decided to visit her lover, who lived in the countryside nearby. The castle was situated on an island in a wide, fast-flowing river. A drawbridge linked the island to the mainland at the narrowest point of the river.

"Surely my husband will not return before dawn," she thought and ordered her servants to lower the drawbridge and leave it down until she returned. After spending several pleasant hours with her lover, the baroness returned to the drawbridge, only to find it blocked by a gateman wildly waving a long, cruel knife.

"Do not attempt to cross this bridge, Baroness, or I will have to kill you," he cried. "The baron ordered me to do so".

Fearing for her life, the baroness returned to her lover and asked him for help. "Our relationship is only a romantic one," he said. "I will not help."

The baroness then sought out a boatman on the river, explained her plight to him, and asked him to take her across the river in his boat.

"I will do it but only if you can pay my fee of five marks."

"But I have no money with me!" the baroness protested.

"That is too bad. No money, no ride," the boatman said flatly.

Her fear growing, the baroness ran crying to the home of a friend and after explaining her desperate situation, begged for enough money to pay the boatman his fee.

"If you had not disobeyed your husband, this would have happened," the friend said. "I will give you no money."

With dawn approaching and her last resource exhausted, the baroness returned to the bridge in desperation, attempted to cross to the castle, and was slain by the gateman.

Which character is most responsible for the Baroness' death?

- | | | |
|-----------|-------------------|----------|
| —Baron | —Baroness's lover | —Gateman |
| —Baroness | —Baroness' friend | —Boatman |

Appendix B

Using the CI technique

1. In the first part of the experiment, you are going to generate solutions to a personal problem you are having. Use the **red** pen to list solutions to your problem right now.
2. Now you are going to place your solutions into a computer program. It is easy to enter your ideas into the computer. For each idea, you create a "card." Use the mouse to move the cursor to an open part of the screen and click the **left** mouse button. This will create a card. Then you simply one idea on each card. If you would like to move a card, move the mouse to position the cursor over the card. Hold the **left** mouse button down and drag the card. When it is re-positioned, release the left mouse button.
3. Go ahead and put the ideas you created into the program so you can get familiar with how it works.
4. Next you need to read a story and discuss the question that follows with the experimenter and other participants.
5. Now continue generating solutions to your original problem using the computer program.
6. Finally, we need you to rate all of your solutions using the solution rating sheet provided by the experimenter.

Appendix C

The PB Technique to Problem Solving

In this experiment, we will show you a problem solving technique and let you practice it. These instructions will introduce you to the technique.

Consider the following problem:

Chris needs \$300 to pay for damages to his or her dorm room. Chris has one month to come up with the money or be evicted. Think of as many different ways as you can that Chris could solve this problem.

Assume that a person came up with the following list of ideas.

borrow money from parents	babysit	sell car
get a part time job	borrow money from friend	borrow from brother
sell tv	get a temporary job	borrow from bank

When people are generating ideas, after awhile they often get stumped. They just can't think of any more. One technique that may help a person to continue to generate ideas is called brainstorming. There are four simple rules:

Rule 1: Defer Judgments

Do not judge ideas until you have thought of as many as possible. Sometimes people cannot think of other ideas because are too critical of the ones they generate. Try not to be. Think of possibilities. Sometimes poor ideas can be springboards to really good ideas. In the example above, Chris may not realistically be able to borrow from a bank. But don't dwell on the unrealistic quality, try to think of other ideas.

Rule 2: Generate as many solutions as you can

Try to think of as many solutions as you can. The more you can think of, the better your chances of thinking of one you will think is best. In the list above, there are only nine solutions. That really isn't very many. With the experimenter discuss **three ideas of**

your own that could solve Chris's problem. When you are finished go on with the instructions.

Rule 3: Write down all of your ideas

Many people refuse to write down some ideas . It is OK to include wild, unusual, and unique ideas. Sometimes unique ideas are desirable. Sometimes they are stepping stones to really great ideas. For example, a person who thinks of selling a TV, may think of selling their body (not such a good idea). But this may lead them to think of selling blood, which might be a good idea.

Rule 4: Combine and build on existing ideas

If you get stuck, go back over the ideas you have produced to see if you can combine any of them to make new ideas. For example, in the list of solutions above, we might combine two for the idea: "get a part time job in a bank."

Keeping these rules in mind, discuss with the experimenter three more of your own ideas. After you the discussion, continue with the instructions.

--STOP and talk with the experimenter--

Let us briefly review the rules of brainstorming:

Rule 1: Defer judgment of your ideas.

Rule 2: Generate as many ideas as you can

Rule 3: Write down all your ideas

Rule 4: Combine and build on existing ideas

If you understand the technique, you are ready to begin the experiment. Let the experimenter know that you are ready.

Appendix D

Using the CB Technique

In this experiment, we will show you a problem solving technique and let you practice it. These instructions will introduce you to the technique.

Consider the following problem:

Chris needs \$300 to pay for damages to his or her dorm room. Chris has one month to come up with the money or be evicted. Think of as many different ways as you can that Chris could solve this problem.

Assume that a person came up with the following list of ideas.

borrow money from parents	babysit	sell car
get a part time job	borrow money from friend	borrow from brother
sell tv	get a temporary job	borrow from bank

It is easy to enter such ideas into the computer. For each idea, you create a “card.” Use the mouse to move the cursor to an open part of the screen and click the **left** mouse button. This will create a card. Then you simply one idea on each card.

If you would like to move a card, move the mouse to position the cursor over the card. Hold the **left** mouse button down and drag the card. When it is re-positioned, release the left mouse button.

Go ahead and put the ideas you already created into the program so you can get familiar with how it works.

When people are generating ideas, after awhile they often get stumped. They just can't think of any more. One technique that may help a person to continue to generate ideas is called brainstorming. There are four simple rules:

Rule 1: Defer Judgments

Do not judge ideas until you have thought of as many as possible. Sometimes people cannot think of other ideas because they are too critical of the ones they generate. Try not to be. Think of possibilities. Sometimes poor ideas can be springboards to really good ideas. In the example above, Chris may not realistically be able to borrow from a bank. But don't dwell on the unrealistic quality, try to think of other ideas.

Rule 2: Generate as many solutions as you can

Try to think of as many solutions as you can. The more you can think of, the better your chances of thinking of one you will think is best. In the list above, there are only nine solutions. That really isn't very many. With the experimenter discuss **three ideas of your own that could solve Chris's problem**. When you are finished go on with the instructions.

Rule 3: Write down all of your ideas

Many people refuse to write down some ideas. It is OK to include wild, unusual, and unique ideas. Sometimes unique ideas are desirable. Sometimes they are stepping stones to really great ideas. For example, a person who thinks of selling a TV, may think of selling their body (not such a good idea). But this may lead them to think of selling blood, which might be a good idea.

Rule 4: Combine and build on existing ideas

If you get stuck, go back over the ideas you have produced to see if you can combine any of them to make new ideas. For example, in the list of solutions above, we might combine two for the idea: "get a part time job in a bank."

--STOP and talk with the experimenter--

Let us briefly review the rules of brainstorming:

Rule 1: Defer judgment of your ideas.

Rule 2: Generate as many ideas as you can

Rule 3: Write down all your ideas

Rule 4: Combine and build on existing ideas

Review of Using the Computer Program:

1. To add a new idea, use the mouse to move the cursor to some place on the screen and click the **left** mouse button. This will create a card. Type idea.
2. To move an idea, use the mouse to move the cursor to one of the ideas. Press and hold the **left** mouse button down. Moving the mouse will move the card.

Appendix E

The PH Technique for Problem Solving

In this experiment, we will show you a problem solving technique and let you practice it. These instructions will introduce you to the technique.

Consider the following problem:

Chris needs \$300 to pay for damages to his or her dorm room. Chris has one month to come up with the money or be evicted. Think of as many different ways as you can that Chris could solve this problem.

Assume that a person came up with the following list of ideas.

borrow money from parents	babysit	sell car
get a part time job	borrow money from friend	borrow from brother
sell tv	get a temporary job	borrow from bank

When people are generating ideas, after awhile they often get stumped. They just can't think of any more. One technique that may help a person to continue to generate ideas is called the hierarchical technique. There are three simple rules:

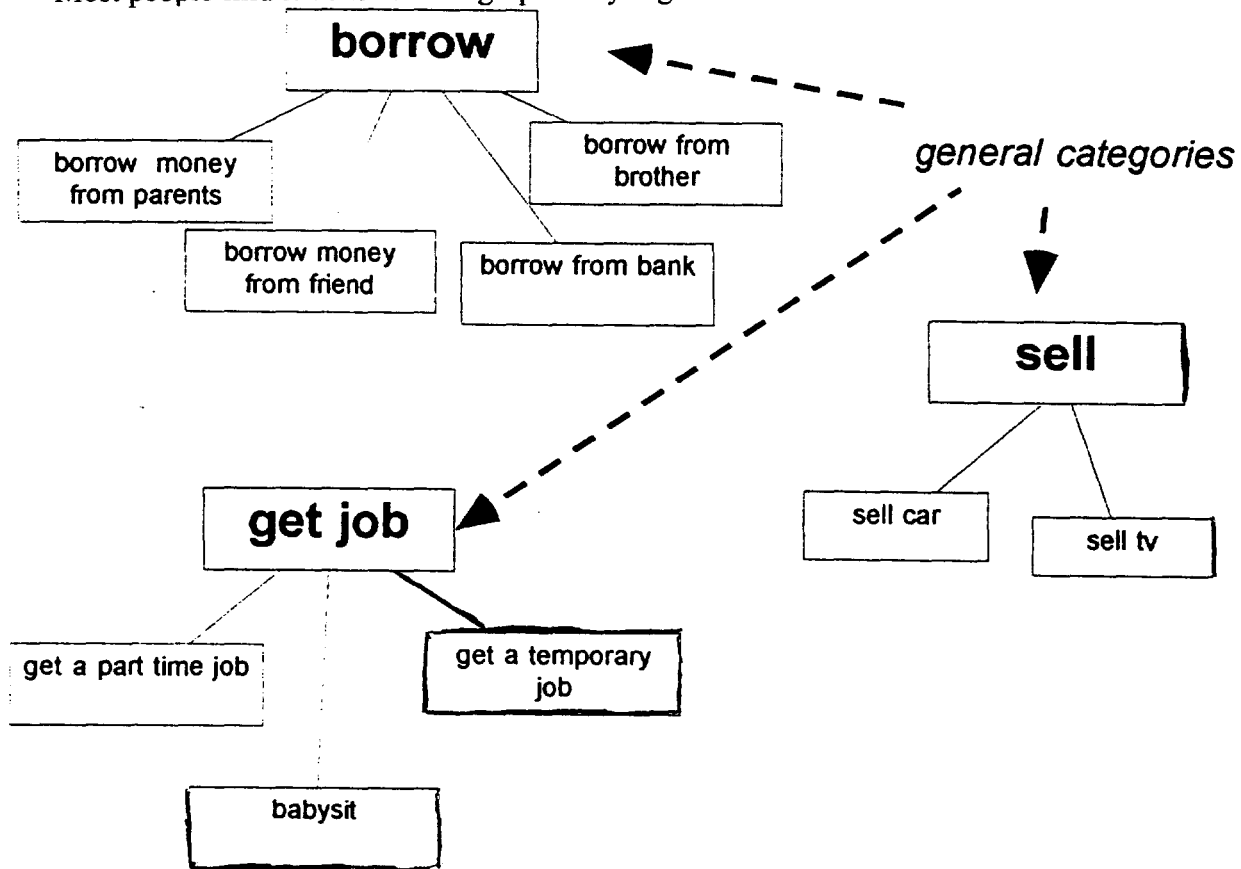
Rule 1: Find "general" solutions.

There are several ways to discover general solutions. One way is to examine solutions to see if **two or more have something in common**. There are at least three general solutions that can be found in the list above.

Please try to find three general solutions now.

--STOP and talk with the experimenter---

Most people find it beneficial to graphically organize their ideas as follows:



(Note that related ideas are near each other and are connected by lines)

Rule 2: Generate new ideas that are types of the general ones

Once you have organized your ideas, most people find it easy to think of other ideas that are examples of the general categories. See if you can add one or two related ideas of your own to each of the general ideas.

Rule 3: Consider opposites of ideas

Sometimes you can come up with good ideas if you consider opposites of ideas (especially general categories). For example, the opposite of borrow is loan. Perhaps Chris could make money by loaning something.

--STOP and talk with the experimenter--

Let us quickly review the hierarchical technique:

1. Start with an initial list of ideas (you have a list from the problem you have been working on right before you got these instructions).

2. Identify general ideas. This can be done by:

looking for two or more ideas with something in common

questioning whether one idea is an example of something

deciding if one idea is a way to do something

Often it is useful to graphically organize ideas by grouping them and connecting them with lines.

3. Generate new ideas that are examples of the general ones.

4. Consider opposites.

Appendix F

Using a CH Technique

In this experiment, we will show you a problem solving technique and let you practice it. These instructions will introduce you to the technique.

Consider the following problem:

Chris needs \$300 to pay for damages to his or her dorm room. Chris has one month to come up with the money or be evicted. Think of as many different ways as you can that Chris could solve this problem.

Assume that a person came up with the following list of ideas.

borrow money from parents	babysit	sell car
get a part time job	borrow money from friend	borrow from brother
sell tv	get a temporary job	borrow from bank

It is easy to enter such ideas into the computer. For each idea, you create a "card." Use the mouse to move the cursor to an open part of the screen and click the **left** mouse button. This will create a card. Then you simply one idea on each card.

Go ahead and put the ideas you already created into program so you can get familiar with how it works.

When people are generating ideas, after awhile they often get stumped. They just can't think of any more. One technique that may help a person to continue to generate ideas is called the hierarchical technique. There are three simple rules:

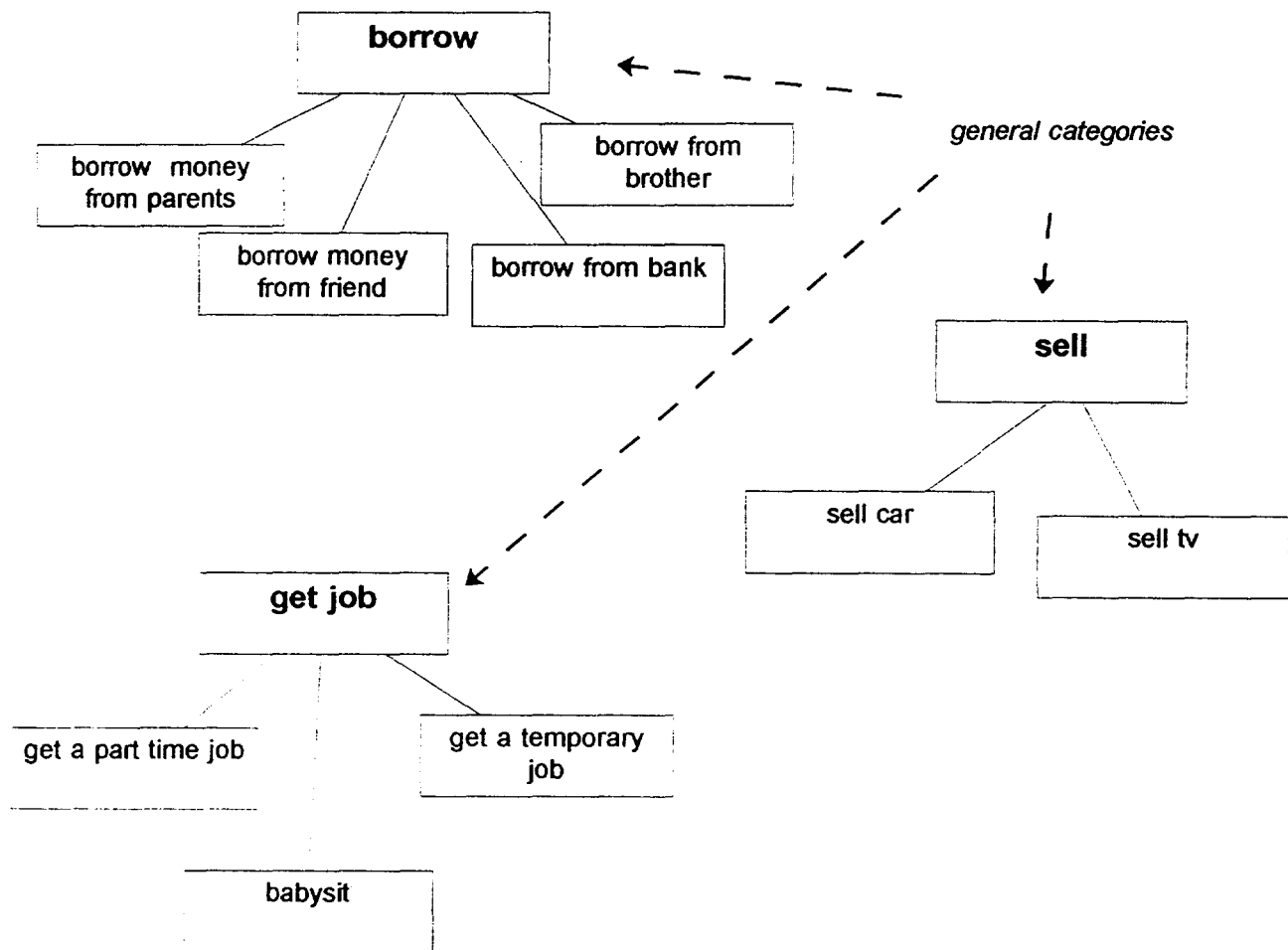
Rule 1: Find "general" solutions.

There are several ways to discover general solutions. One way is to examine solutions to see if **two or more have something in common**. There are at least three general solutions that can be found in the list above.

Please try to find three general solutions now.

--STOP and talk with the experimenter---

Most people find it beneficial to graphically organize their ideas. Using the computer, you can move your ideas around so that common ones are close together. To move an idea card, use the mouse to move the cursor to the card. Press the **left** mouse button and hold it down. While the mouse button is pressed, the card will move around as you move the mouse around. If you entered and organized the ideas from the prior page, they could look something like this:



Note that the cards are connected by lines. When you work on your problem, you may also find it desirable to connect the boxes with lines. To connect two cards, use the mouse to move the arrow to one of the cards. Click the **right** mouse button. The card will change color. Use the mouse to move the cursor to another card. Click the **right** mouse button on it. The color will disappear and the line will appear. (You can erase lines by repeating this process)

There are some other important and useful rules:

Rule 2: Generate new ideas that are types of the general ones

Once you have organized your ideas, most people find it easy to think of other ideas that are examples of the general categories. See if you can add one or two related ideas of your own to each of the general ideas.

Rule 3: Consider opposites of ideas

Sometimes we can come up with good ideas if we consider opposites of the ideas (especially general categories) we had already thought about. For example, the opposite of borrow is loan. Perhaps Christ could make money by loaning something.

--STOP and talk with the experimenter--

Let us quickly review the hierarchical technique:

1. Start with an initial list of ideas (you have a list from the problem you have been working on right before you got these instructions). Type one idea per card.

2. Identify general ideas. This can be done by:

looking for two or more ideas with something in common

questioning whether one idea is an example of something

deciding if one idea is a way to do something

Often it is useful to graphically organize ideas by grouping them and connecting them with lines.

3. Generate new ideas that are examples of the general ones.

4. Consider opposites.

Review of Using the Computer Program:

1. To add a new idea, use the mouse to move the cursor to some place on the screen and click the **left** mouse button. This will create a card. Type idea.

2. To move an idea, use the mouse to move the cursor to one of the ideas. Press and hold the **left** mouse button down. Moving the mouse will move the card.

3. To connect cards, use the mouse to move the cursor to one. Press the **right** button and the card will change color. Use the mouse to move the cursor to the other card. Again press the **right** button.

Appendix H

Using the PI technique

1. In the first part of the experiment, you are going to generate solutions to a personal problem you are having. Use the **red** pen to list solutions to your problem right now.
2. Next you need to read a story and discuss the question that follows with the experimenter and other participants.
3. Now you need to continue generating solutions to your problem. Please add solutions to your current list using the **black** pen.
4. Finally, we need you to rate all of your solutions using the solution rating sheet provided by the experimenter.